

Sports and Traumatic Brain Injury in Youth Under 21 years of Age, Louisiana, 1996-1999: *Facts, Figures, and Prevention*

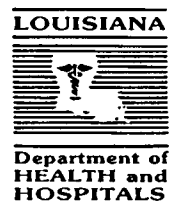


Injury Research and Prevention Section



STATE OF LOUISIANA
DEPARTMENT OF HEALTH AND HOSPITALS

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INTRODUCTION:

Traumatic brain injuries (TBI) and spinal cord injuries (SCI) are among the leading causes of death and disability of children and youth under 21 years of age in the United States. Each year TBI results in an estimated 3,000 deaths, 29,000 hospitalizations, and 400,000 emergency department visits.¹ There are two types of traumatic brain injury: primary and secondary. Primary injury is any injury that occurs acutely (i.e. as a result of trauma to the head). It includes skull fractures, contusions (brain bruises), intra-cranial bleeding (hematomas), lacerations, and diffuse axonal injuries that occur from shearing forces as the brain “bounces” around inside the skull. These injuries can result in secondary injury, which is delayed injury occurring at a cellular level. Secondary injury produces the severe long-term effects of traumatic brain injury.

Although the most frequent sports-related injuries requiring medical attention are fractures, the most severe are head injuries. Traumatic brain injury often results in concussion. A concussion is acute bruising of the brain that results in mental status changes. The symptoms of concussion may range from quite subtle (forgetting the date) to very dramatic (garbled speech, loss of use of an extremity). Loss of consciousness does not occur with all concussions. Contact sports place the athlete at a higher risk for repeat concussion, which can lead to “second impact syndrome” (SIS).² This is a rare, often fatal, sudden and rapid swelling of the brain, occurring most often in children. SIS usually occurs after multiple mild concussions, as in the case of the Colorado high school football player who died in the early 1990’s after multiple mild concussions in a one-week period.

There are several published guidelines for the grading and management of concussion in sport. The Centers for Disease Control and Prevention (CDC) promotes the recommendations of the American Academy of Neurology³ (Table 5).

LOUISIANA FACTS AND FIGURES:

The emotional and monetary costs to the individual, family members, and society are substantial. Because of the significant impact TBI and SCI have on society, CDC's National Center for Injury Prevention and Control (NCIPC) developed a model TBI surveillance system. In 1996, the Traumatic Brain Injury Act was signed, enabling the national implementation of the model. CDC provides funding for selected states to collect data regarding incidence, etiology, and risk factors of TBI. Louisiana was one of 15 states to receive funding for the 1996-1999 surveillance period. This report summarizes those findings.

Between 1996 and 1999, there were 4,724 youth under 21 years of age in Louisiana identified with a TBI or SCI meeting the case definition. Approximately one fourth of the cases each year were randomly sampled to ascertain the cause of injury. Due to small numbers, the racial categories are black, white, and "other". The leading categories for external cause of injury in Louisiana, in descending order, are motor vehicle crashes (including pedestrian injuries), falls, "other" (which includes sport and recreation injuries), and violence. It is important to note that the most common cause of TBI varies according to age group, and that blacks are over-represented in almost every category. Falls are the leading cause of injury in children (under five years of age) and the elderly (65 years and older). These statistics are comparable to national statistics. Motor vehicle crashes are the leading cause of injury for children 5-21 years of age. An annual breakdown of TBI for all external cause of injury categories by year follows:

Table 1: 1996 TBI for youth under 21 years of age

| Race | | Age | | Discharge Disposition | |
|-------|-----|-----------|-----|-----------------------|-----|
| white | 680 | 0-4 Yrs | 285 | Home | 696 |
| black | 494 | 5-9 Yrs | 185 | Facility | 51 |
| other | 20 | 10-14 Yrs | 187 | Death | 291 |
| | | 15-20 Yrs | 579 | Other | 59 |

1236 TBI and SCI occurred, of which 96% were TBI only, 70% were male, 55% were white, 47% were 15-20 years of age, 5.9% were sport-related, 56% were discharged to home, and 24% died.

Table 2: 1997 TBI for youth under 21 years of age

| Race | | Age | | Discharge Disposition | |
|-------|-----|-----------|-----|-----------------------|-----|
| white | 679 | 0-4 Yrs | 291 | Home | 737 |
| black | 481 | 5-9 Yrs | 174 | Facility | 69 |
| other | 24 | 10-14 Yrs | 178 | Death | 289 |
| | | 15-20 Yrs | 572 | Other | 52 |

1215 TBI and SCI occurred, of which 96% were TBI only. 68% were male, 56% were white, 47% were 15-20 years of age, 7.4% were sport-related, 61% were discharged to home, 24% died.

Table 3: 1998 TBI for youth under 21 years of age

| Race | | Age | | Discharge Disposition | |
|-------|-----|-----------|-----|-----------------------|-----|
| white | 720 | 0-4 Yrs | 309 | Home | 810 |
| black | 461 | 5-9 Yrs | 180 | Facility | 63 |
| other | 22 | 10-14 Yrs | 176 | Death | 266 |
| | | 15-20 Yrs | 553 | Other | 48 |

1218 TBI and SCI occurred, of which 97% were TBI only. 67% were male, 59% were white, 45% were 15-20 years of age, 5.4% were sport-related, 67% were discharged to home, and 22% died.

Table 4: 1999 TBI for youth under 21 years of age

| Race | | Age | | Discharge Disposition | |
|-------|-----|-----------|-----|-----------------------|-----|
| white | 736 | 0-4 Yrs | 316 | Home | 825 |
| black | 430 | 5-9 Yrs | 182 | Facility | 51 |
| other | 12 | 10-14 Yrs | 175 | Death | 236 |
| | | 15-20 Yrs | 526 | Other | 70 |

1199 TBI and SCI occurred, of which 96% were TBI only. 67% were male, 61% were white, 44% were 15-20 years of age, 5.4% were sport-related, 69% were discharged to home, and 20% died.

RECOMMENDATIONS FOR INJURY PREVENTION IN A VARIETY OF POPULAR SPORTS:

The goal of data collection is to provide information that enables individuals and agencies to identify possible prevention strategies. This section describes a number of popular sports and specific strategies to prevent injury. General recommendations for injury prevention in *any* sport include taking a good history regarding previous head injury and evaluation by a pediatrician to determine general developmental readiness.⁴

Football is probably the most popular team sport in America and is the second most dangerous contact sport with respect to the number of sport-related injuries (basketball is number one). In 2000, an estimated 358,500 injuries in children under 24 years of age were reported.⁵ Data available in a 1982 publication by Bruce et. al estimated that accidental TBI and SCI in children under 15 years of age occurs at a rate of 230 per 100,000 per year.⁶ The rates are slightly higher in the 15-24 year old age group.⁶ There were no rules of play when the sport began. Gradually, the rules are changing to decrease the number of head and neck injuries. The most significant change occurred in 1976, when new football rules made it illegal to butt block, face tackle, or spear. Implementation of this rule decreased the number of head fatalities by 20% when comparing frequencies in the decade 1965-1974, and the decade 1975-1984.⁶

Recommendations for reducing head and neck injuries include:

- Mandatory pre-participation history and physical.
- A physician or athletic trainer should be present at all games and practices.
- Implementation and emphasis of neck-strengthening exercises.
- Coaches should drill in the proper execution of blocking and tackling.
- Enforcement of the rules against spearing during practice and in games.
- Strict enforcement of the rules by coaches and officials.
- Immediate medical attention and assessment for concussion based on the aforementioned American Academy of Neurology recommendations.

Basketball is one of the few contact sports that does not require protective head gear (i.e. helmets). It accounts for the most reported sport-related injuries in the year 2000 (approximately 473,000 injuries in kids under 24 years of age).⁵ In 1999, a study by Powell and Barber-Foss⁷ reported results of a 3-year surveillance project of mild traumatic brain injury for various high school sports. The rates for basketball for mild TBI were 750 per 100,000 player-seasons for boys and 1040 per 100,000 player-seasons for girls. Recommendations for injury prevention strategies include:

- Control the environment by enforcing the rules of the game, improve player skills, and modify teaching techniques.
- Early identification of mild TBI and adherence to the recommendations for staging and post-TBI participation.
- Report all suspected injuries to team physicians and trainers.

Baseball is America's favorite pastime. Two to eight percent of all participants are injured each year.^{8,9} In 2000, an estimated 213,359 injuries were reported for children 0 to 24 years of age (this number combines baseball and softball injuries).⁵ Direct contact with the ball is most often the cause of injury and death. The CPSC performed a study in 1995, which found that protective equipment reduces the number and severity of injuries by more than one-third¹⁰.

Recommended equipment and prevention measures from the CPSC Study include:

- Baseball protective equipment currently on the market may prevent, reduce, or lessen the severity of more than 58,000 injuries or almost 36 percent an estimated 162,100 hospital emergency-room-treated, baseball-related injuries occurring to children each year.
- Softer-than-standard balls may prevent, reduce, or lessen the severity of the 47,900 ball impact injuries to the head and neck.
- Batting helmets with face guards may prevent, reduce, or lessen the severity of about 3,900 facial injuries occurring to batters in organized play.
- Safety release bases that leave no holes in the ground or parts of the base sticking up from the ground when the base is released may prevent, reduce, or lessen the severity of the 6,600 base-contact sliding injuries occurring in organized play.

Soccer is one of the most popular team sports in the world. In 2000, an estimated 154,000 U.S. kids (ages 0-24 years) sustained injuries.⁵ Most of these injuries are mild (strains, sprains, and bruises to the lower extremity). However, approximately 5% of all soccer injuries are acute head injuries,¹¹ of which approximately 20% are concussions.¹² In recent years attention has been given to the potential cognitive effects of “heading” the ball. A case-control study in Norway found that 80% of tested adult soccer players who began playing soccer at a young age had mild to severe deficits in concentration, attention, and memory compared to players who do not “head” the ball frequently.¹³ Further research needs to be conducted before the rules and regulations of soccer will change to decrease the risk of closed head injury. Meanwhile, the following tips are from SAFE USA--Soccer Safety,¹¹ a program sponsored by CDC:

- Ask your child’s doctor if it is safe for your child to “head” the ball, and make sure your child knows how to do it correctly.
- Don’t let your child climb on the goal post or hang or swing from the crossbar.
- Encourage your child's league to use waterproof, synthetic balls instead of leather. Leather balls can become waterlogged and very heavy, making them dangerous for play.
- Make sure movable soccer goals are anchored to the ground at all times, not just during play.
- Goal posts have been known to tip over in strong winds or when climbed on, causing severe injuries.

Non-motorized scooters gained tremendous popularity after their release in 2000. With increased use there were also more injuries, many of which required treatment in hospital emergency rooms. Most of the injuries (an estimated 1730 in the year 2000)⁵ are to children under 15 years of age. The majority of injuries are preventable by using appropriate gear. The CPSC has developed the following recommendations⁵:

- Wear a helmet, knee and elbow pads at all times.
- Ride during daylight hours on smooth, paved surfaces free of traffic.

A similar trend is occurring with motorized scooters. The same recommendations apply.

However, the CPSC advises that children under 12 should not ride motorized scooters.¹⁴

Hockey is the official sport of Canada and very popular in the United States. It is mentioned here because there are so many head injuries sustained each year. In 2000, there were an estimated 54,000 injuries in the U.S. to kids under 24 years of age.⁵ A Canadian study¹⁵ determined there were between 463 and 595 concussions per 100,000 player-game hours with the first hockey-related concussion at the average age of 15 years. Most concussions were a result of contact with the ice or side-boards and elbowing. Recommendations for preventing injury include:

- Wear certified helmets and replace them after each head injury.
- Early identification of mild TBI and adherence to the recommendations for staging and post-TBI participation.
- Strict adherence to the rules of the game.

Swimming is a wonderful exercise for people of all ages. However, many injuries occur around swimming pools. In 2000, there were an estimated 104,000 injuries (kids under 24 years of age)⁵ associated with pools, swimming, and equipment. It is vital to teach all children water safety at a young age. Remember, just because children know how to swim doesn't mean they are safe from the dangers of drowning. Tips from CDC to prevent drowning include¹⁶:

- Teach all children how to swim.
- Children should always swim under the supervision of an adult who can swim well.
- Adults should refrain from drinking alcohol while supervising children.
- Children should be aware of the dangers of mixing swimming and alcohol.
- Always swim with a buddy.
- Always check the water with feet first. Never dive into unknown waters or where the bottom can't be seen.
- Never swim during a thunderstorm.
- Pools should be surrounded by a fence, at least 4-feet tall, with a self-closing and self-locking gate.
- Place a phone near the pool in case of emergency or if friends call so that the supervising adult doesn't leave the poolside.

Skateboarding and In-line skating are popular among youths and adults alike. These two activities pose significant risk for injuries, often requiring treatment in an emergency department. There were an estimated 220,000 injuries from skateboarding and in-line skating in 2000,⁵ of which 60% are to children under 15 years of age.¹⁷ The majority of injuries occur in the first week of riding and after a year of experience (when the rider becomes more daring and tries doing stunts).¹⁷ Several factors play a role in injuries: inadequate protective equipment, riding on irregular surfaces, tail-gating from moving vehicles, and faulty equipment.

Recommendations for safer riding include:

- Wear an approved helmet, padded clothing, boarding gloves, wrist guards, and slip-resistant shoes. In-line skaters should also include elbow and knee pads.
- Proper maintenance of board/skate (check for nicks in wheels, cracks, broken parts, sharp edges).
- Learn how to fall.
- Skate during daylight hours.

Skiing and Snowboarding are popular winter sports with significant risk for injury, especially for those people who take “ski holidays”. A study comparing the number of injuries among first-time skiers to first-time snowboarders found that there were an equal number of injuries (4%), but that snow-boarding injuries were more serious (usually upper extremity and head).¹⁸ Until recently, wearing a hat was the best way to keep warm. However, the latest trend on the slopes is to don a helmet. Not only is the helmet warm, it is the best way to prevent head injury should the rider have an unfortunate encounter with a tree or other object.

Other ways to prevent injury during these popular wintertime sports include:

- Getting in shape before the season starts.
- Always ride with a buddy.
- Use the proper equipment.
- Don’t ski/ride beyond your ability.

Bicycling is a popular recreational activity and mode of transportation. Unfortunately, many cities are not “bike-friendly”. They don’t have designated bike routes and drivers and cyclists are poorly educated about sharing the road with each other. With these dangers, it is imperative to wear a proper-fitting helmet when riding a bike. Statistics indicate that bike helmet use decreases the risk of head injury by almost 90%.¹⁹ Biking has the most injuries among sports and recreational equipment. In 2000, there were an estimated 469,000 injuries (children under 24 years). Children ages 5-14 years sustained the most injuries (approximately 336,250).⁵

Tips for your children before they get on a bike include:

- Wear an approved helmet at all times!
- Ride *with* the flow of traffic.
- Always be aware of your surroundings. Look back periodically to check for cars and other cyclists. Always look back to the left before swerving to avoid an obstacle.
- Signal before turning—remember, the bicycle is a *vehicle*.
- Don’t wear loose-fitting pants and be sure to tuck long shoelaces into shoes.
- Wear light-colored clothing—white is best.
- Bicycles should have reflectors in front, back, and on the wheels.
- Avoid riding a bike at night. Cars can’t see you!

Table 5: American Academy of Neurology Concussion Grades, Definitions, and Return to Play Guidelines

| Concussion Grade | Definition | Return to Play Guidelines |
|------------------|--|---|
| 1 | No loss of consciousness. Transient confusion. Concussion symptoms resolve in <i>less than 15 minutes</i> . | Athlete may return to play if asymptomatic for 15 minutes. |
| 2 | No loss of consciousness. Transient confusion. Concussion symptoms last <i>more than 15 minutes</i> . | Athlete may return to play if asymptomatic for one week. |
| 3 | Any loss of consciousness, either brief (seconds) or prolonged (minutes). | Athlete should be transported to a hospital emergency department; after brief (seconds) concussion, athlete should be withheld from play until asymptomatic at rest and exertion for one week; if athlete had prolonged loss of consciousness (minutes), may return to play when asymptomatic at rest and exertion for 2 weeks. |

**Information taken from American Academy of Neurology Guidelines³

Appendix A

Contacts for prevention information regarding motor vehicle crashes, violence, and falls:

| | |
|--|----------------|
| Louisiana Office of Public Health | |
| Injury Research and Prevention Section | (504) 568-2509 |
| Louisiana Safe Kids | (504) 568-2508 |

Websites with information regarding TBI:

| | |
|--|--|
| American Academy of Neurology | www.aan.com |
| Brain Injury of Association of America | www.biausa.org |
| Think First Foundation | www.thinkfirst.org |
| National Safe Kids | www.safekids.org |
| National Youth Sports Safety Foundation | www.nyssf.org |
| Consumer Product Safety Commission | www.cpsc.gov |
| National Athletic Trainers Association | www.nata.org |
| American Academy of Orthopaedic Surgeons | www.aaos.org |

Remember, October is designated as "Brain Injury Awareness Month".

Appendix B

Case Definition

The following case definitions are those recommended by the Centers for Disease Control and Prevention.

Traumatic Brain Injury

A case of traumatic brain injury (TBI) is defined as either an occurrence of injury to the head that is documented in a medical record with one or more of the following conditions attributed to head injury:

- observed or self-reported decreased level of consciousness
- amnesia
- skull fracture
- objective neurological or neuropsychological abnormality
- diagnosed intracranial lesion
- occurrence of death resulting from trauma, with head injury listed on the death certificate, autopsy report, or medical examiner's report in the sequence of conditions that resulted in death

Spinal Cord Injury

A case of spinal cord injury is defined as the occurrence of an acute traumatic lesion of neural elements in the spinal canal (spinal cord and cauda equina), resulting in any degree of sensory deficit, motor deficit, or bowel or bladder dysfunction, either temporary or permanent.

The clinical definition of spinal cord injury excludes the following:

- intervertebral disc disease
- vertebral injuries in the absence of spinal cord injury
- nerve root avulsions and injuries to nerve roots and peripheral nerves outside the spinal canal
- birth trauma
- cancer, spinal cord vascular disease, and other nontraumatic spinal cord diseases

Methods

The Louisiana TBI-SCI surveillance system has two components: hospital data and mortality data.

Hospital Data

There are 149 hospitals in Louisiana currently licensed by the Department of Health and Hospitals. Currently, data is requested from 118 of these hospitals. Hospitals that were excluded from this request included facilities that specialized in rehabilitation only, psychiatric care only, labor and delivery only or some other specialty. We requested a printout from each hospital based on ICD-9-CM codes and date of discharge. Each hospital submitted a printout of all persons who were admitted to the hospital and discharged between January 1, 1996 and December 31, 1999 who had at least one diagnostic code for a traumatic brain or spinal cord injury. The printouts contained the following variables:

| | |
|------------------------|------------------------|
| -name | -race |
| -medical record number | -date of birth |
| -date of admission | -discharge disposition |
| -date of discharge | -zip code |
| -gender | -all ICD-9-CM codes |

This data was entered into a computer database and a random sample of TBI was selected. Office of Public Health personnel then traveled to the various hospitals to abstract additional data from sampled TBI cases and all SCI cases. The following additional variables were obtained from hospital records:

| | |
|---|-------------------------------|
| -social security number | -address |
| -method of payment | -cause of injury |
| -place of injury | -parish of injury |
| -work relatedness of injury | -intentionality |
| -motor vehicle position (if applicable) | -drug and alcohol involvement |
| -use of personal protective equipment (if applicable) | |
| -level of consciousness | -presence of skull fracture |
| -presence of intracranial lesion | -presence of amnesia |
| -level and extent of spinal cord injury | |

Mortality Data

Louisiana maintains a file of all deaths of state residents. These data include information concerning residence, gender, race, date of birth, date of death, place of injury, and ICD-9 codes for the nature and external cause of injury and personal identifiers. To capture pre-hospitalization deaths, these data were queried for persons who died as a result of a TBI or SCI from 1996 to 1999. Those persons were matched with persons identified through the hospital data and only entered once.

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